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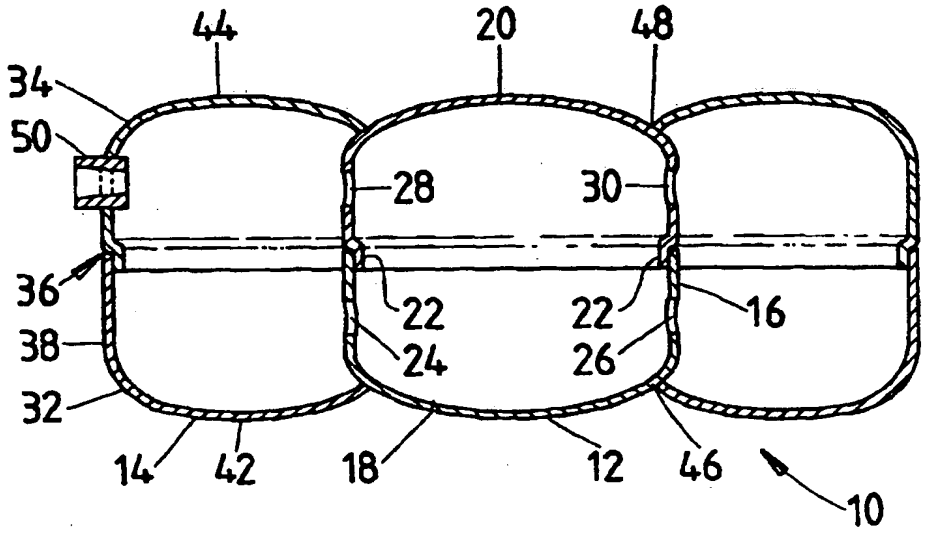

(57) Abstract

A pressurized fuel vessel (10) for automotive use has a greater diametrical dimension than axial dimension and is defined by a preformed enclosure (12) whose peripheral wall (16) comprises a reinforcing wall of the vessel having openings (24, 26, 28, 30) therethrough, and an annular portion (14) which is welded to the enclosure to define with the enclosure the chamber of the fuel vessel. The opposed ends (42, 44) of the annular portion conveniently radially inwardly overlap the peripheral wall of the enclosure and are welded to the opposed ends (18, 20) of the enclosure.

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PRESSURIZED FUEL VESSEL

The present invention relates to a pressurized fuel vessel which, while it is adapted for automotive use, may be used in other areas.

Conventional pressurized liquid fuel cylinders for automotive use are constructed in three pieces with two dished ends welded circumferentially to a cylindrical portion which is formed by rolling plate steel and welding the opposed edges together. Such a cylinder may occupy a substantial amount of space in the boot of a vehicle, and in some small cars there is insufficient room to fit such a cylinder of requisite size.

It has been previously proposed to provide an automobile pressurized fuel vessel which is shaped and sized to fit into a well in the floor of the boot of the automobile which would otherwise accommodate a spare wheel for the automobile so as to reduce the volume of space in the boot occupied by the vessel. GB 2095808 discloses a toroidal vessel and NL 7703630 discloses a somewhat squashed substantially toroidal vessel in which the axis of the vessel is sealed off by a sleeve to define a toroidal chamber for the fuel.

One of the problems of providing a fuel vessel which on the one hand is adapted to fit into the spare wheel well of an automobile and on the other hand accommodates as much fuel as possible is that it must have a generally circular cross-section and have a substantially greater diametrical than axial dimension. This presents considerable difficulties in providing sufficient strength in the axial end walls which are proposed to be overcome in the aforementioned patent specifications by giving the end walls a considerable degree of external convexity while also reinforcing the axis by providing the aforementioned toroidal structure. Both such strength-giving proposals tend to reduce the internal volume of the vessels.

An improved pressurized fuel vessel allowing greater internal volume is described in AU 637693 and the corresponding WO92/06324 in my name in which there is provided a pressurized fuel vessel for automotive or other use having opposed axial end walls connected at or adjacent an outer periphery to define an enclosed chamber, said vessel being of greater diametrical dimension than axial dimension, with internal reinforcing means extending between the opposed axial end walls, the internal reinforcing means comprising at least one reinforcing wall means which extends within the chamber at least substantially about an axis of the vessel intermediate the axis and the outer periphery, and the at least one reinforcing wall means being adapted to permit pressurized fuel to flow between portions of the chamber respectively disposed radially inwardly and radially outwardly thereof.

The present invention is directed to an improvement of the embodiments of pressurized fuel vessel described in my aforementioned earlier patent applications although many of the optional features described therein may be adopted with the present invention and my earlier patent applications are therefore incorporated herein by reference.

According to the present invention there is provided a pressurized fuel vessel for automotive or other use having opposed axial end walls connected at or adjacent an outer periphery to define an enclosed chamber, said vessel being of greater diametrical dimension (as herein defined) than axial dimension, and wherein internal reinforcing means extends between the opposed axial end walls, said internal reinforcing means comprising a reinforcing wall which extends within the chamber about an axis of the vessel intermediate the axis and the outer periphery, said reinforcing wall being adapted to permit pressurized fuel to flow between portions of the chamber respectively disposed radially inwardly and radially outwardly thereof, wherein said vessel comprises a preformed enclosure having opposed ends and a peripheral wall defining, respectively, radially inner portions of the opposed axial end walls of the vessel and the reinforcing wall whereby the enclosure forms the radially inwardly disposed portion of the chamber, and said vessel further comprises an annular portion secured to the enclosure to form the radially outwardly disposed

portion of the chamber, said annular portion defining radially outer portions of the opposed axial end walls and the outer periphery of the vessel, said reinforcing wall having at least one opening therethrough to permit said fuel flow.

The term "preformed" as used in "preformed enclosure" herein should be construed merely to mean the enclosure is formed at some stage before the annular portion is secured to the enclosure.

Where the pressurized fuel vessel in accordance with the invention is used in an automobile, it may advantageously be sized to fit into a spare wheel well in the boot of the automobile. As is well known, the well may be provided in the floor of the boot or, for example, in a wing of the automobile in which case the vessel would likely only be partially received in the well in an upright manner. Alternatively, the fuel vessel may be supported externally, as for example in a truck.

The vessel preferably has a substantially circular cross-section (optionally with a segmental portion removed therefrom to allow the vessel to fit better in a well in a wing of an automobile) and the term "diametrical dimension" should be construed in relation to the smallest circle within which the vessel can be located. Thus, the cross-section may be rectangular or any other non-circular cross-section, such as ellipsoidal, if desired. The axis about which the reinforcing wall extends will usually be the central axis of such smallest circle, but not necessarily, depending upon the shape of the annular portion. Thus, the term "annular portion" should be construed merely as meaning that said portion extends about the preformed enclosure. The preformed enclosure may itself have any suitable cross-section, but preferably circular.

As with a spare wheel and tire combination, the diametrical dimension of the fuel vessel is preferably at least twice the axial dimension, and, for example, the respective dimensions may be 600 mm and 240 mm, but where the vessel is intended to fit in the spare wheel well the dimensions may be determined by the size of the well.

The internal reinforcing means is provided to reduce the minimum permissible thickness of the opposed axial end walls of the vessel.

The internal reinforcing means may include additional reinforcing means to the reinforcing wall, for example another reinforcing wall and/or one or more columns which extend parallel to the axis of the vessel and which are welded or otherwise secured to the opposed axial end walls. One column may be on the axis of the vessel and/or plural columns may be equally angularly spaced about the axis. The fuel vessel may be secured in position in the automobile or other support by, for example external strapping, but in one embodiment the or at least one of the columnar reinforcing means projects through at least one of the opposed axial end walls and may be threaded exteriorly of the chamber to facilitate securement of the vessel either directly to the support or through appropriate strapping. The or at least one of the columnar reinforcing means may be hollow and open at each end to the exterior of the vessel to receive a locating bolt or stud therethrough.

The outer periphery of the vessel is most preferably defined by a substantially axially extending outer wall which may be strengthened if necessary by, for example, giving it a rippled configuration or by making it externally convex.

The preformed enclosure is conveniently formed in steel and may have convex opposed ends to increase their strength. Since the pressure on both sides of the peripheral wall of the preformed enclosure will be the same in use of the vessel, no special reinforcing of the peripheral wall of the preformed enclosure is required. Thus, preferably the peripheral wall of the preformed enclosure is substantially cylindrical.

The preformed enclosure may be formed in a variety of ways which will be well understood by those skilled in the art, but in a preferred embodiment it is formed as two shells which are welded together around the peripheral wall, most preferably as two substantially identical shells which are welded together along a diametrical plane which intersects the centre of the preformed enclosure. However, the two

shells need not be substantially identical, and one of the shells may comprise a greater part of the peripheral wall than the other, or all of the peripheral wall, but preferably the two shells are welded together along a diametrical plane.

The annular portion of the vessel may also conveniently be formed in steel and is most advantageously welded to the preformed enclosure. In a preferred embodiment, the annular portion radially inwardly overlaps the peripheral wall of the preformed enclosure and is secured at each end to the respective opposed end of the preformed enclosure. Advantageously, the radially outer portions of the opposed axial end walls of the vessel defined by the annular portion are convex.

With the annular portion overlapping the preformed enclosure, it is necessary to form the annular portion in at least two parts which are secured together, preferably by welding, around the preformed enclosure. Advantageously, two parts are formed as substantially identical shells which are welded together on the outer periphery of the vessel along a diametrical plane which intersects the centre of the vessel. However, the two shells need not be substantially identical, and one of the shells may comprise a greater part of the peripheral wall than the other, or all of the peripheral wall, but preferably the two shells are welded together along a diametrical plane.

One embodiment of a pressurized fuel vessel in accordance with the present invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a sectional view of the vessel taken along the axial plane I-I in Figure 2; and

Figure 2 is a plan view of the vessel.

The vessel 10 is formed of mild steel and comprises a preformed inner enclosure 12 and an annular outer enclosure 14.

The preformed enclosure has a cylindrical peripheral wall 16 and opposed convex

nd walls 18 and 20. The inner enclosure is formed in two substantially identical halves which are secured together along a diametrical plane which intersects the centre of the vessel by a joggle-butt weld 22.

The peripheral wall 16 has a variety of openings therethrough, 24, 26, 28 and 30, to allow fluid flow therethrough between the inner enclosure 12 and outer enclosure 14.

The outer enclosure 14 is formed from two substantially identical annular shells 32 and 34 which are welded together at a joggle-butt joint 36 in the axially extending peripheral wall 38 of the vessel 10. The axial opening 40 (see Figure 2) defined by the shells 32 and 34 has a smaller diameter than the diameter of the inner enclosure 12 so that shells 32 and 34 are welded together after they have been disposed over the respective end walls 18 and 20 of the inner enclosure.

The axial end portions 42 and 44 of the annular outer enclosure 14 are also convex when viewed on respective sides of the axis of the vessel, and the radially inner edges thereof defining the opening 40 abut the end walls 18 and 20 of the inner enclosure at approximately right angles, for example between 80 and 100°, adjacent where those end walls 18 and 20 merge with the peripheral wall 16. The annular joins are then welded exteriorly at 46 and 48.

The axial lengths of the inner and outer enclosures 12 and 14 are substantially the same so that the opposed end walls of the vessel defined by the wall portions 18 and 42 and 20 and 44, respectively, extend substantially in respective planes.

A valve 50 is shown generally in the peripheral wall 38 of the vessel and may be in the form of a known multi-valve assembly. Alternatively, plural valve openings may be provided. An advantage of providing the convex formations 18 and 42 in the bottom axial end wall of the vessel (when the vessel is used in the orientation shown in Figure 1) is that the internal concavity of the inner enclosure 12 defined by the end wall 18 beneath the openings 24 and 26 may act as a reserve of fuel which is

tapped only after the fuel in the remainder of the vessel has been used.

Both the inner and outer enclosures may conveniently be formed in, for example, mild steel or stainless steel and the inner enclosure can advantageously be formed on a production line for small pressurized gas vessels such as are used for barbeques. A major advantage of the vessel 10 is the simplicity of manufacture since the shells 32 and 34 of the outer enclosure can be automatically centralised on the inner enclosure prior to welding. Since the internal reinforcing wall is integrally formed with the inner enclosure, it may give improved strength and fatigue or pulsation resistance to the vessel as a whole while allowing substantially greater internal volume for fuel storage than the known toroidal vessels. Furthermore, it will be noted that the weld lines all extend perpendicularly to the longitudinal axis of the vessel which gives considerably greater strength than longitudinal welds.

It will be appreciated that the joggle-butt welds may be replaced by, for example, butt welds using a backing plate.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. It is to be understood that the invention includes all such variations and modifications which fall within its spirit and scope.

CLAIMS:

1. A pressurized fuel vessel for automotive or other use having opposed axial end walls connected at or adjacent an outer periphery to define an enclosed chamber, said vessel being of greater diametrical dimension (as herein defined) than axial dimension, and wherein internal reinforcing means extends between the opposed axial end walls, said internal reinforcing means comprising a reinforcing wall which extends within the chamber about an axis of the vessel intermediate the axis and the outer periphery, said reinforcing wall being adapted to permit pressurized fuel to flow between portions of the chamber respectively disposed radially inwardly and radially outwardly thereof, wherein said vessel comprises a preformed enclosure having opposed ends and a peripheral wall defining, respectively, radially inner portions of the opposed axial end walls of the vessel and the reinforcing wall whereby the enclosure forms the radially inwardly disposed portion of the chamber, and said vessel further comprises an annular portion secured to the enclosure to form the radially outwardly disposed portion of the chamber, said annular portion defining radially outer portions of the opposed axial end walls and the outer periphery of the vessel, said reinforcing wall having at least one opening therethrough to permit said fuel flow.

2. A pressurized fuel vessel according to Claim 1 wherein the opposed ends of the preformed enclosure are convex.

3. A pressurized fuel vessel according to Claim 1 wherein the outer periphery of the preformed enclosure is substantially cylindrical.

4. A pressurized fuel vessel according to Claim 1 wherein the preformed enclosure comprises two shells which are welded together around the peripheral wall.

5. A pressurized fuel vessel according to Claim 4 wherein the two shells are substantially identical and are welded together along a diametrical plane which intersects the centre of the preformed enclosure.

6. A pressurized fuel vessel according to Claim 4 or Claim 5 wherein the two shells are welded together by a joggle-butt weld.

7. A pressurized fuel vessel according to Claim 1 wherein the at least one opening through the peripheral wall of the preformed enclosure is spaced from the opposed ends of the preformed enclosure.

8. A pressurized fuel vessel according to Claim 1 wherein the annular portion of the vessel is welded to the preformed enclosure.

9. A pressurized fuel vessel according to Claim 8 wherein the radially outer portions of the opposed axial end walls of the vessel defined by the annular portion meet the preformed enclosure at approximately right angles.

10. A pressurized fuel vessel according to Claim 1 wherein the radially outer portions of the opposed axial end walls of the vessel defined by the annular portion are convex.

11. A pressurized fuel vessel according to Claim 1 wherein the annular portion radially inwardly overlaps the peripheral wall of the preformed enclosure and is secured at each end to the respective opposed end of the preformed enclosure.

12. A pressurized fuel vessel according to Claim 1 wherein the annular portion is formed in two parts which are secured together.

13. A pressurized fuel vessel according to Claim 12 wherein the two parts are formed as substantially identical shells which are welded together on the outer periphery of the vessel along a diametrical plane which intersects the centre of the vessel.

14. A pressurized fuel vessel according to Claim 1 wherein the outer periphery is defined by a substantially axially extending outer wall of the annular portion.

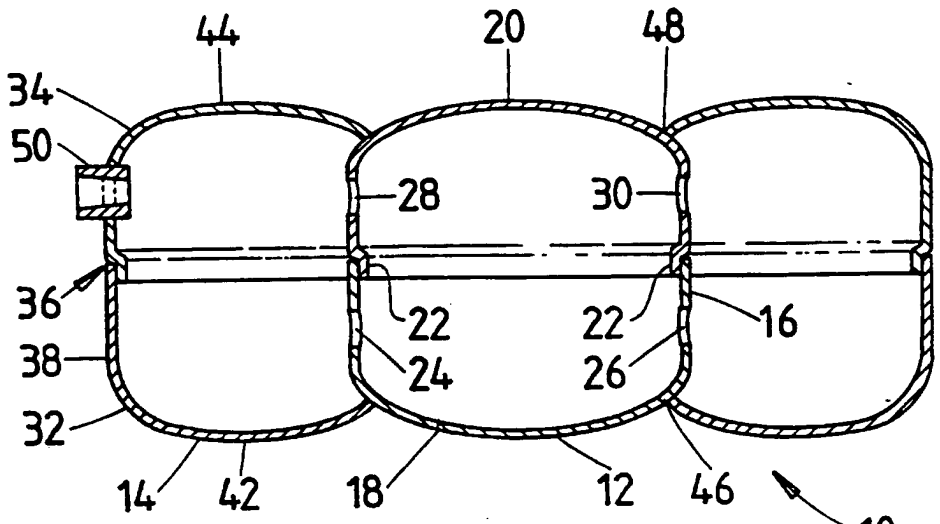

FIGURE 1

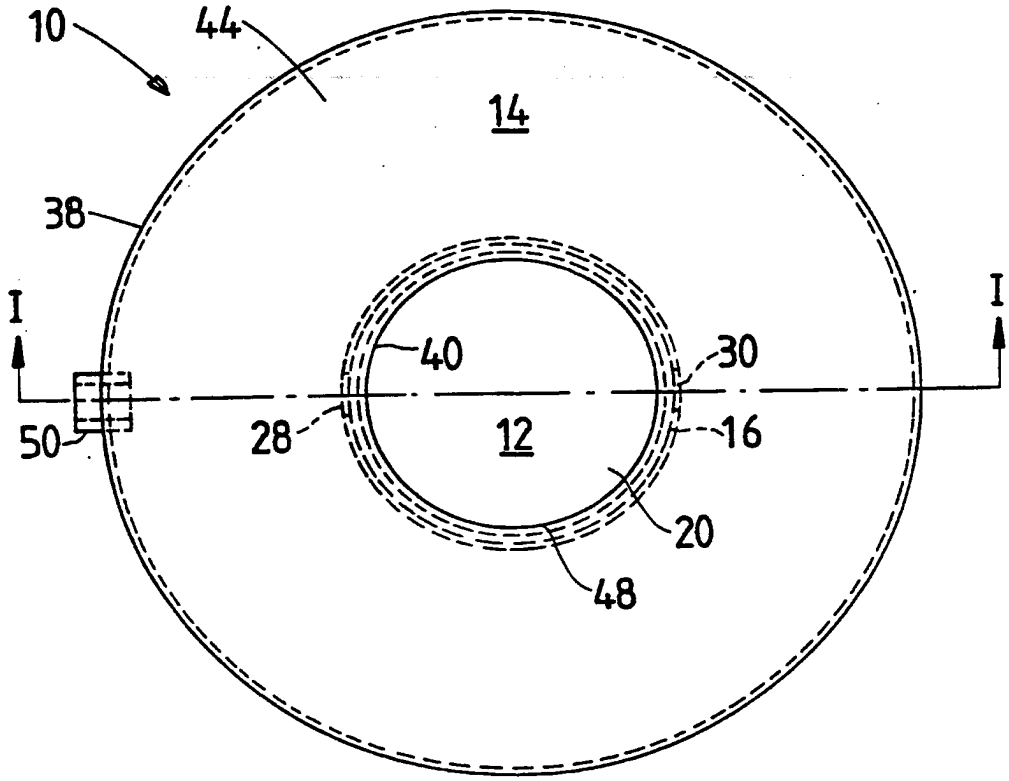

FIGURE 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 94/00375

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl.[5] F17C 1/08, B60K 15/073

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC : F17C 1/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y,A	DE,A, 576315 (DEBOR et al), 10 May 1933 (10.05.33) Figures	1-14
Y,A	DE,A, 581413 (DEBOR et al), 27 July 1933 (27.07.33) Figures	1-14
Y,A	DE,A, 705439 (RIBI), 28 April 1941 (28.04.81) Figures	1-14
Y,A	DE,A, 1944315 (FRESE), 4 March 1971 (04.03.71) Figures	1-14

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
X,Y	WO,A, 92/06324 (ROBINSON), 16 April 1992 (16.04.92) Claims, Figures	1-14
Y	US,A, 2920784 (BOARDMAN), 12 January 1960 (12.01.60) Figures	1-14
Y	GB,A, 595135 (CHICAGO BRIDGE & IRON COMPANY), 27 November 1947 (27.11.47) Figures	1-14

INTERNATIONAL SEARCH REPORT
Information on patent family member

International application No.
PCT/AU 94/00375

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
WO	9206324	AU	86473/91	EP	552210
					END OF ANNEX